

Role of water and mineral metabolism

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Role of water

Points to be discussed

- ❖ Function of water
- ❖ Distribution of water
- ❖ Water balance
- ❖ Cause of water imbalance
- ❖ Disease due to water imbalance

Function

Solvent for cellular component

Carrier for nutrition and waste product

Regulate body temperature

Regulate Electrolyte balance

Lubricate joints and pleura

Distribution

Water constitute 70 percent of body weight

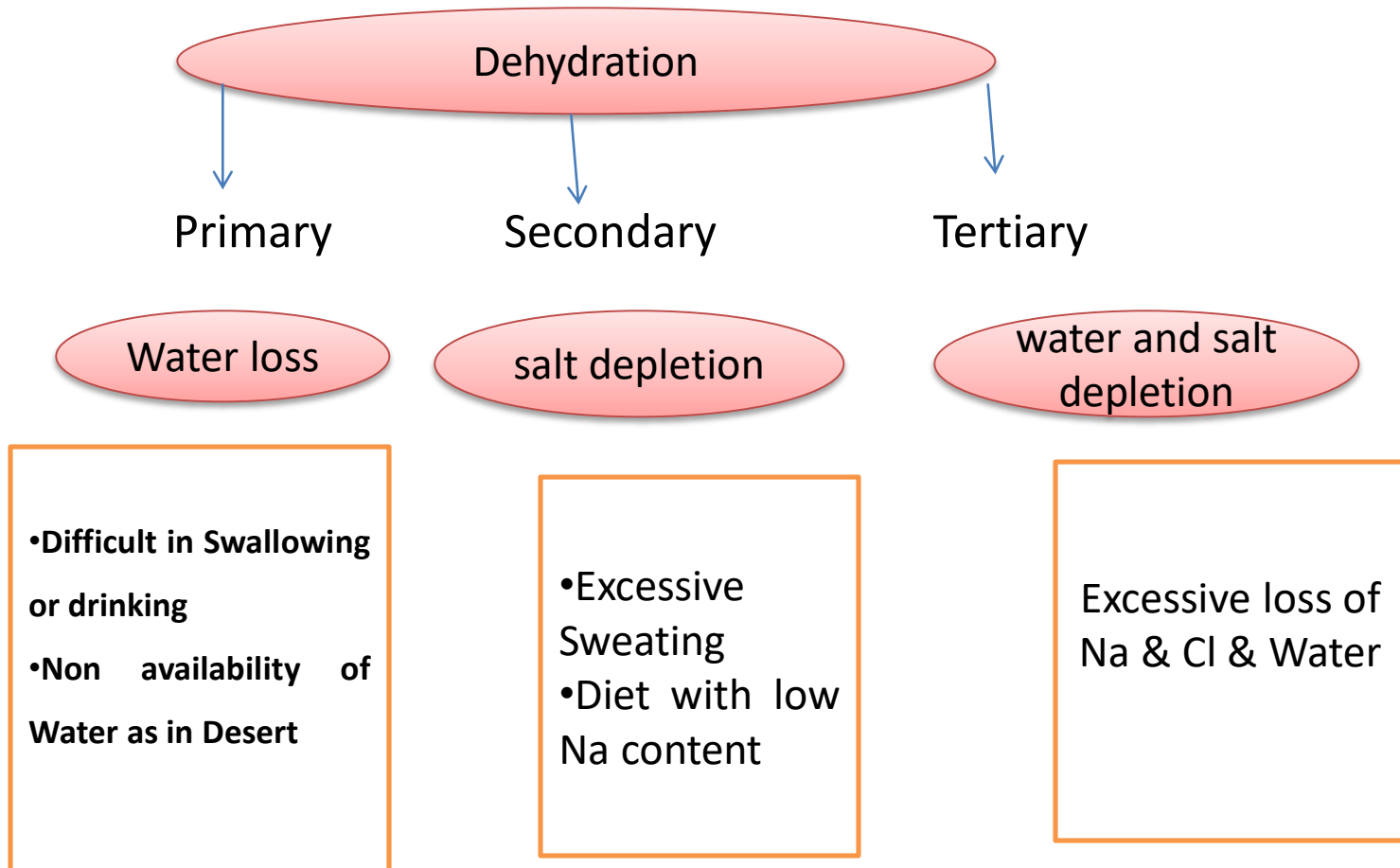
Distributed as extra cellular and intra cellular water

Extra cellular water includes plasma,connective tissue,transcellular fluid(CSF,endolymph).

Disease due to water imbalance

Water excess leads to edema or swelling of body

Water loss leads to dehydration ,classified into 3 types



MINERAL METABOLISM

- controlled by parathyroid hormone (PTH), calcitonin and vitamin D

function of calcium:

- ❖ structural unit of bones and teeth
- ❖ contraction and relaxation of muscles
- ❖ stabilizes nervous tissue
 - low calcium --- irritable nerves --- tetany
 - high calcium --- depresses the nervous irritability
- ❖ required for blood clotting
- ❖ activates various enzymes (glycogen phosphorylase kinase, salivary and pancreatic amylase)

Source: milk, cheese, eggs, beans, fish.

Deficiency of calcium leads to TETANY, RICKETS, OSTEOMALACIA and OSTEOPOROSIS.

PHOSPHOROUS

- Nucleic acids Phospholipids Phosphoproteins Coenzymes (vitamins)
- It maintains the Ph of urine and blood
- Deficiency leads to rickets and osteomalacia
- Source is same as calcium

Sodium

- functions include:
- osmotic equilibrium
- acid-base balance
- carbon dioxide transport
- cell membrane permeability
- muscle irritability

food sources: table salt, salty foods (potato chips, pretzels, etc.), baking soda, milk.

sodium deficiency:dehydration,acidosis,tissue atrophy.

sodium excess:edema (hypertonic expansion),hypertension.

Potassium

functions:

buffer constituent, acid-base balance, water balance, membrane transport, neuromuscular irritability

Food sources: vegetables, fruit (bananas), whole grains, meat, milk

deficiency (hypokalemia) causes:

increased and profound weakness of skeletal muscle (paralysis and impaired respiration). weakness anomalies of smooth muscles, cardiac : AV block, cardiac arrest.

excess (hyperkalemia) causes:

- sudden increased intake
- severe tissue trauma and burns
- acute and chronic acidosis

symptoms:

- weakness and paralysis
- cardiac anomalies (impaired conduction, fibrillations, cardiac arrest)

Chloride

- an essential anion
- closely connected with sodium in foods, body tissues and fluids and excretions
- important for osmotic balance, acid-base balance and in the formation of gastric HCl.

Deficiency of chloride leads to Hypochloremic - alkalosis, hypovolemia, pernicious vomiting, psychomotor-disturbances.

Magnesium(Mg): cofactor of all enzymes involved in phosphate transfer reactions that use ATP and other nucleotidtriphosphates, phosphatases, pyrophosphatases.

CNS effect : hypomagnesemia leads to CNS irritability, disorientation, psychotic behavior, convulsions.

neuromuscular system effect:

magnesium has a direct depressant effect on skeletal muscle
magnesium also causes a decrease in Ach release at motor end plate (used in treatment of eclamptic seizures).

Iron(Fe)

- Essential constituent of haemoglobin, otherwise known as component of respiratory enzyme cytochrome oxidase.
- Obtained from meat, kidney, liver, egg yolk and fish.
- Its maximum absorption takes place at the first part of duodenum.
- *Apo ferritin* is necessary for its absorption in absence of apo ferritin there is no absorption of iron.

Function:

- Transports oxygen to tissue.
- Takes part in cellular oxidation and reduction process.
- Acts as co-enzyme for enzyme succinate dehydrogenase.
- Deficiency of iron leads anaemia.
- Excess of iron leads to hemochromatosis (bronzed pigmentation of the skin).

Note: mucosal block-iron absorbed in the body in required amount. even in anaemia only the required amount is absorbed to meet the deficiency rest are excreted. this phenomena is called mucosal block.

Sulphur:

- ❖ This is a constituent of sulphur containing amino acid.
- ❖ Responsible for synthesis of protein keratin.
- ❖ Synthesizes SH-group containing enzyme.
- ❖ Constituent of vitamin biotin and lipoic acid.

Iodine:

- ❖ It is necessary for synthesis of thyroid hormone.
- ❖ It is obtained from sea foods and vegetables grown near the sea coast.
- ❖ Deficiency of iodine leads to disease GOITER i.e enlargement of thyroid prevented by taking iodised salt.

Fluorine :

- ❖ Fluorine is present in bone and teeth.
- ❖ Excess of fluorine leads to dental fluorosis leads to mottling(coloring) and pitting(hole) of teeth.

Copper :

- ❖ It is widely present in all tissue.
- ❖ It is a constituent of enzyme .
- ❖ It is necessary for haemoglobin synthesis and maturation of RBC.
- ❖ Helps in bone formation.
- ❖ Maintain myelin sheath of nerve fibre.
- ❖ Deficiency leads to weight loss, bone disorder, anaemia and demyelination.
- ❖ Wilsons disease: is due to abnormal copper metabolism (increased copper absorption), excess copper deposited in liver leads to cirrhosis, degeneration of brain.

Zinc :

- ❖ Present in the plasma combined with albumin.
- ❖ Constituent of enzyme carbonic anhydrase and alcohol dehydrogenase.

- ❖ Required for insulin secretion.
- ❖ Releases vitamin A from liver.
- ❖ Necessary for wound healing.